



# Study on the Level of Knowledge in Dental Medical Emergencies of Dentistry Students through Neutrosophic Values

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**Abstract.** This research carries out an analysis of the level of knowledge in dental medical emergencies of tenth semester dentistry students at Universidad Regional Autónoma de los Andes UNIANDES, during the academic period April-August 2019, related to the reception of first aid courses. For this purpose, we made use of the neutrosophic theory, through the application of the single valued neutrosophic set (SVNS) associated to linguistic variables to evaluate the students' answers to the applied questionnaire. As a main result, we obtained a negative evaluation of the level of knowledge of dental medical emergencies for the students who have not received the first aid course.

**Keywords:** single valued neutrosophic set; aggregation operator; scoring function; dental medical emergencies

## 1 Introduction

Medical emergencies occur relatively frequently in the dental office [1] either as medical or dental emergencies. They can be triggered by stress or the administration of medications such as local anesthetics [2], which can cause episodes of syncope and hyperventilation [3], especially in adult patients with pre-existing pathologies.

It is therefore essential that dentistry students and professionals have the basic knowledge to ensure the initial diagnosis and management, to prevent the occurrence of fatal complications [4]. It is considered an emergency to those unpredictable risk situations that affect the patient's life and therefore require immediate attention. There are triggers factors such as stress, therapeutic and pharmacological management [5].

Advances in the field of health have generated a longer life expectancy in patients, so that today the professional in dentistry is already caring for elderly patients with systemic diseases that increase the incidence of emergency situations in the dental office [2].

Effective management of an emergency situation in the dental office is responsibility of the dentist, who must be able to diagnose the signs and symptoms and control them properly. If this is achieved, the professional will be able to provide a more complete and safe treatment [6].

When a medical emergency arises at the dental office, the dentist must be a competent professional, so it is essential to have basic knowledge to make a proper initial diagnosis and management of dental medical emergencies.

Preparation for medical emergencies is related to the training capacity of university centers and to the continuous updating of the professionals. That is why the objective of this investigation is to determine the impact of the first aid courses in the level of knowledge of dental medical emergencies of tenth semester students at Universidad Regional Autónoma de los Andes UNIANDES.

## 2 Description of previous research

Although there are few studies that evaluate the level of training of dental students in a medical emergency, the scientific search reports some research works as a background, such as:

Casco & Jaquett [7] determined the level of knowledge of fifth and sixth year students of the School of Dentistry of the Pierre Fauchard Autonomous University of Paraguay on the management of medical emergencies that may occur during dental consultations, by applying a survey concluding that the level of knowledge was unfavorable by 56%.

Díaz & Castañeda [8] applied a 20-questions questionnaire with topics of diagnosis of dental medical emergencies, first aid and pharmacological management, and concluded that the level of knowledge of dental medical emergencies of the students of the seventh and ninth semesters of Dentistry at Universidad Privada Antonio Guillermo Urrullo, Cajamarca, Peru, is bad, with 66.3%.

Torres [9] determined the level of knowledge about the management of dental emergencies such as, management of dental-alveolar trauma, infectious processes, hemorrhages and pain, through the application of a structured questionnaire to the students of the Dentistry Clinic "Luis Vallejos Santoni" at Universidad Andina del Cusco, concluding that their level of knowledge is predominantly regular.

Villena [10] in his research work about medical emergencies during dental consultation of fifth and sixth year students of dentistry at Universidad Nacional de Trujillo, 2013, by applying a survey of 20 questions concluding that the level of knowledge is low in 65.3%, medium 34.7%, not reporting high level.

In Ecuador, Rodriguez [11] determined the level of knowledge about dental medical emergencies during dental outpatient visits among students of the School of Dentistry at the UCE, using a survey made up of 26 closed questions, concluding that the level of knowledge was better among ninth-semester students than eighth-semester ones.

In his thesis "Protocols for dental medical emergencies more frequent in the central zone of the country", Paredes [12] used a questionnaire with questions about dental medical emergencies to make protocols.

In this work, we propose the use of neutrosophic theory to evaluate the level of knowledge of students in dental medical emergencies.

Neutrosophy, which was proposed by Smarandache for the treatment of neutralities, has prepared the basis for a series of mathematical theories that generalize the classical and fuzzy theories such as the neutrosophic sets and the neutrosophic logic [13-15].

The original definition of truth value in the neutrosophic logic is shown below [16]:

Let  $N = \{(T, I, F): T, I, F \subseteq [0,1]\}$  n, a neutrosophic valuation is a mapping of a group of propositional formulas to  $N$ , and for each  $p$  statement you have

$$v(p) = (T, I, F) \quad (1)$$

Neutrosophic sets theory starts from classical sets theory and fuzzy sets theory, adding a membership function to the set  $\mu$  generally defined as an  $x$ -number between 0 and 1 (the interval  $[0,1]$ , instead of the classical binary membership defined in the set  $\{0,1\}$ ). Thus, we introduce the concept of a neutrosophic set associated to a certain linguistic value, defined by a word, adjective or linguistic label  $A$ , [17-19].

It can be said that a neutrosophic set  $A$  is defined as a membership function that links or matches the elements of a domain or universe of discourse  $X$  with items in the  $[0,1]$  range:  $A: X \rightarrow [0,1]$  [18, 20-22]. For each neutrosophic set, a  $\mu_A(x)$  membership or inclusion function is defined, which represents the degree to which a value for the variable  $x$  is included in the concept represented by the label  $A$ . The closer  $A(x)$  is to the value 1, the greater is the membership degree of the object  $x$  to the set  $A$ . The values of membership vary between 0 (no belonging at all) and 1 (total membership) so that a neutrosophic set is a class of objects with continuous degrees of membership [16, 23].

### 3 Methods

To demonstrate the impact that first aid courses have, students were given a diagnosis of their knowledge in the detection and treatment of medical and dental emergencies.

The population we studied were all the tenth semester dentistry students during the period April-August, 2019 at Universidad Regional Autónoma de los Andes UNIANDÉS. Since the population is less than 100 people (only 24 students), it was not required to calculate the sample size. Therefore, 100% of the students from the tenth semester who met the inclusion and exclusion criteria were taken into account. In this case these criteria were based on the students' availability to participate in the study. Four students out of 24, did not participate, so the sample was made up of 20 students[24-26].

For the collection of information, a 26 question questionnaire was applied to the students. The first two questions were designed as closed question, to characterize the student as to whether he or she had received a first aid course and whether it was theoretical or practical. The remaining questions were open, ten of which were focused on testing the students' knowledge on diagnosis and fourteen on testing the students' knowledge about the treatment of dental medical emergencies.

The questionnaire we applied was adapted from the scientific article "Level of knowledge about the management of medical emergencies of the fifth and sixth year students of the School of Dentistry at Facultad de Odontología de Universidad Autónoma del Paraguay Pierre Fauchard", published by Casco and Jaquett [7] and shown below.

#### Questionnaire

Have you participated in a first aid course?

If yes, please clarify whether it was theoretical or practical.

What is an emergency situation for you?

What medical emergency has the clinical signs of sudden loss of consciousness, disappearance of carotid pulses, heart sounds, severe mucocutaneous paleness and cyanosis?

What is the medical emergency for clinical signs of loss of consciousness, pallor, sweating, and decreased pulse?

What are the main clinical signs for diagnosing a seizure syndrome?

What medical emergency is presented with a picture of seizures, tachycardia, hypotension, increased breathing rate, nausea, and vomiting?

What clinical signs in a patient can orient our diagnosis towards a severe anaphylaxis during the dental consultation?

When a patient goes through a picture of diastolic blood pressure greater than 120 mm hg, headache, eye injuries (bleeding, exudates), hematuria and seizures, what can be diagnosed?

What can be treated the clinical signs of the presence of strong abdominal pain, vomiting, tachypnea, and when the glucometer registers values higher than 200mg/dl of blood glucose?

What can be diagnosed when the picture begins with a productive cough accompanied by bronchospasm, intense dyspnea, intercostal muscle retractions (pulling) and cyanosis of the lip and nail base mucosa?

What clinical signs in a patient can orient our diagnosis towards an acute airway obstruction during the dental consultation?

If a vasovagal syncope is present in the patient, it is recommended to place him/her in the Lemburg Train or anti-shock position. What does this position consist of?

In hypertensive emergencies, what is the therapeutic behavior that we should follow?

With respect to laboratory tests, what are the normal values of coagulation time and bleeding time?

Hyperventilation syndrome appears when the anxious patient begins to breathe rapidly, abnormally eliminating  $CO_2$ . What should you do in this case?

What measures would you take if the patient suffers an acute airway obstruction in your practice?

How would you counteract critical hyperglycemia in a patient's office?

What behavior would you adopt if your patient begins to suffer from a seizure syndrome in your dental care?

In a severe situation of local anesthetic poisoning, what type of medication would you administer to your patient to counteract his or her main clinical sign (seizure)?

What steps would you take in a situation of anaphylaxis in your patient?

What type of medication would you administer to your patient if an acute asthmatic crisis occurs during your patient's care in the dental office?

What are the normal values of breathing rate in a healthy patient?

If a patient breathes in a foreign body while sitting in a dental chair and begins to cough and have difficulty breathing, what steps should be taken to treat this emergency?

If while in the office waiting room, a patient begins to experience tachycardia, dizziness, palpitations, malaise, chest tightness, blood pressure of 150/110 hg, what is happening to him/her?

In a picture of oral bleeding, what signs and symptoms will give us reference that an adult patient lost a blood volume of approximately 650cc to 1000cc in an oral surgery?

For the analysis of the results, three experts (specialists in dentistry who teach first aid courses at UNIANDES) were asked to qualitatively evaluate each response. For this purpose, we proposed the use of single valued neutral sets (SVNS) which allow the use of linguistic variables and increase the interpretability in the recommendation models and the use of indeterminacy [16, 27].

Let  $X$  be a universe of discourse, a SVNS  $A$  over  $X$  has the following form:

$$A = \{ \langle x, u_a(x), r_a(x), v_a(x) \rangle : x \in X \} \quad (2)$$

Where

$$u_a(x): X \rightarrow [0,1], r_a(x): X \rightarrow [0,1] \quad \text{and} \quad v_a(x): X \rightarrow [0,1]$$

With

$$0 \leq u_a(x), r_a(x), v_a(x) \leq 3, \quad \forall x \in X$$

The intervals  $u_a(x), r_a(x)$  y  $v_a(x)$  denote the memberships to true, indeterminate and false from  $x$  in  $A$ , respectively.

In order to obtain the experts' ratings in the evaluation models, we propose the use of the associated linguistic terms SVN numbers as shown in table 1.

LINGUISTIC TERM	SVN NUMBERS
<b>EXCELLENT</b>	(1; 0; 0)
<b>VERY GOOD</b>	(0,8; 0,15; 0,20)
<b>GOOD</b>	(0,60; 0,35; 0,40)
<b>REGULAR</b>	(0,50; 0,50; 0,50)

<b>REGULAR TENDING TO BAD</b>	(0,40; 0,65; 0,60)
<b>BAD</b>	(0,20; 0,85; 0,80)
<b>VERY BAD</b>	(0; 1; 1)

**Table 1.** Linguistic terms used. Source: Author's elaboration

To aggregate the assessments given by the experts in each question in order to determine the level of knowledge of each student in the fields of diagnosis and treatment of dental medical emergencies, we used the single-valued weighted neutrosophic mean (SVNWA) proposed by Ye [28] and defined as follows:

$$F_w(A_1, A_2, \dots, A_n) = \langle 1 - \prod_{j=1}^n (1 - T_{A_j}(x))^{w_j}, \prod_{j=1}^n (I_{A_j}(x))^{w_j}, \prod_{j=1}^n (F_{A_j}(w))^{w_j} \rangle \tag{3}$$

Where:

$W = (w_1, w_2, \dots, w_n)$  is the vector of  $A_j (j = 1, 2, \dots, n)$  such that  $w_n \in [0,1]$  y  $\sum w_j = 1$ .

In this case it was assumed that all questions have the same weight in both fields, that is,  $w_j$  is equal to 0,10 for questions 3 to 12 and equal to 0,07 for questions 13 to 26. The scoring function was then used to determine each student's level of knowledge in dental medical emergencies in general.

Once the aggregations were obtained, the score function was used to sort the evaluations and to obtain a unique value of assessment in each field by student:

$$s(V_j) = 2 + T_j - F_j - I_j \tag{4}$$

With this value it was possible to obtain a qualitative evaluation of each student by field taking the possible range of scores (from 0 to 3) and divided by 7 (according to the amount of linguistic terms used, which yielded the intervals to classify the scores, as shown in Table 2

SCORING INTERVALS	EVALUATION	LINGUISTIC TERM
[0 - 0,429)	VB	Very bad
[0,429 - 0,857)	B	Bad
[0,857 - 1,286)	RB	Regular tending to bad
[1,286 - 1,714)	R	Regular
[1,714 - 2,143)	G	Good
[2,143 - 2,571)	VG	Very good
[2,571 - 3]	E	Excellent

**Table 2.** Intervals for student evaluation according to score function value. Source: Author's elaboration

From these results, the hierarchical clustering algorithm with Ward link and Euclidean distance measurement was used. With the implementation of the Orange 3.26 package[29], grouping students according to their evaluations in both fields and characterizing the group in general according to their level of knowledge in dental medical emergencies and the influence of the first aid courses received.

### 4 Results

The results of the experts' assessments by questions on diagnosis and treatment of dental medical emergencies are shown in Tables 3 and 4.

STUDENT	EVALUATION BY QUESTIONS									
	1	2	3	4	5	6	7	8	9	10
1	R	B	B	RB	B	RB	B	RB	RB	R
2	VG	B	B	VG	VG	B	B	B	VG	B
3	R	R	R	B	RB	B	R	B	RB	R
4	B	VG	VG	B	B	VG	B	VG	B	VG
5	RB	RB	B	R	RB	B	RB	RB	R	RB
6	RB	B	RB	RB	RB	RB	RB	B	R	R
7	RB	RB	RB	B	RB	RB	R	RB	B	R
8	RB	B	R	RB	R	RB	RB	RB	RB	RB

9	VG	B	VG	B	VG	VG	VG	B	B	B
10	B	RB	RB	R	RB	B	B	RB	RB	RB
11	B	B	B	R	R	RB	R	B	RB	B
12	R	RB	B	B	B	RB	R	RB	B	R
13	B	B	VG	B	VG	VG	B	B	VG	B
14	R	B	B	B	R	RB	B	B	R	B
15	VG	B	VG	B	VG	B	VG	B	VG	VG
16	B	B	B	VG	B	B	VG	B	B	VG
17	B	R	R	B	B	R	R	B	B	B
18	B	RB	B	R	R	RB	B	RB	RB	RB
19	B	B	VG	VG	B	VG	VG	B	VG	VG
20	B	RB	B	B	R	RB	B	RB	B	R

Table 3. Expert evaluation criteria for diagnostic questions. Source: Author's elaboration

STUDENT	EVALUATION BY QUESTIONS													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	RB	RB	RB	B	B	R	R	R	RB	B	R	RB	R	B
2	G	VG	VG	VG	VG	G	VG	G	G	VG	VG	VG	VG	VG
3	R	R	G	RB	R	R	R	R	R	R	R	R	RB	R
4	G	G	VG	VG	G	VG	G	VG	VG	VG	VG	G	G	G
5	RB	G	G	R	RB	G	G	G	G	G	G	RB	G	G
6	G	R	R	R	G	G	RB	RB	G	G	R	R	R	G
7	R	RB	R	R	RB	G	RB	R	G	R	RB	RB	RB	R
8	G	R	RB	RB	R	R	G	R	R	R	G	R	R	G
9	G	G	G	G	G	G	VG	G	G	G	VG	VG	VG	VG
10	R	RB	G	G	RB	R	G	RB	RB	RB	R	G	R	R
11	R	RB	B	R	RB	R	RB	R	B	B	RB	R	R	R
12	RB	B	R	R	B	B	B	B	B	B	RB	B	R	RB
13	G	VG	VG	VG	G	G	VG	VG	G	VG	VG	G	VG	VG
14	B	RB	R	B	RB	RB	R	R	RB	RB	R	RB	RB	B
15	G	VG	G	VG	VG	G	G	G	G	VG	VG	G	VG	VG
16	G	G	G	G	VG	VG	G	VG	G	G	G	VG	VG	VG
17	R	RB	G	R	G	R	G	RB	RB	R	R	RB	R	RB
18	R	R	RB	R	G	R	R	G	G	R	RB	RB	RB	RB
19	VG	G	VG	G	G	G	VG	G	G	VG	G	VG	G	VG
20	R	R	G	RB	RB	RB	G	R	G	R	R	RB	RB	R

Table 4. Expert evaluation criteria for treatment questions. Source: Author's elaboration

We may observe that the evaluations by questions oscillated between Bad and Very Good, without any rating of Excellent or Very Bad in both fields.

The results of the aggregation from the SVNWA operator on diagnosis and treatment of dental medical emergencies are shown in Table 5.

STUDENT	AGGREGATION	
	Diagnosis	Treatment
1	(0,73; 0,218; 0,27)	(0,356; 0,677; 0,644)
2	(0,392; 0,634; 0,608)	(0,398; 0,627; 0,602)
3	(0,611; 0,353; 0,389)	(0,499; 0,496; 0,501)
4	(0,536; 0,441; 0,464)	(0,463; 0,552; 0,537)
5	(0,339; 0,705; 0,661)	(0,469; 0,542; 0,531)
6	(0,754; 0,193; 0,246)	(0,483; 0,522; 0,517)
7	(0,495; 0,504; 0,505)	(0,717; 0,229; 0,283)

8	(0,497; 0,499; 0,503)	(0,535; 0,443; 0,465)
9	(0,524; 0,461; 0,476)	(0,507; 0,483; 0,493)
10	(0,534; 0,445; 0,466)	(0,703; 0,243; 0,297)
11	(0,628; 0,329; 0,372)	(0,717; 0,229; 0,283)
12	(0,637; 0,324; 0,363)	(0,369; 0,664; 0,631)
13	(0,499; 0,494; 0,501)	(0,481; 0,521; 0,519)
14	(0,506; 0,486; 0,494)	(0,667; 0,286; 0,333)
15	(0,66; 0,292; 0,34)	(0,703; 0,243; 0,297)
16	(0,42; 0,602; 0,58)	(0,414; 0,615; 0,586)
17	(0,381; 0,651; 0,619)	(0,651; 0,309; 0,349)
18	(0,676; 0,278; 0,324)	(0,494; 0,502; 0,506)
19	(0,645; 0,313; 0,355)	(0,65; 0,304; 0,35)
20	(0,499; 0,494; 0,501)	(0,486; 0,515; 0,514)

**Table 5.** Aggregation of assessments in the fields of diagnosis and treatment. Source: Author's elaboration

From the aggregations, the score per student was obtained along with it the qualitative evaluation, as shown in table 6.

STUDENT	DIAGNOSIS		TREATMENT	
	Score	Evaluation	Score	Evaluation
1	1,015	RB	1,1403	RB
2	2,144	VG	2,3213	VG
3	1,557	R	1,4838	R
4	2,205	VG	2,2052	VG
5	1,388	R	1,7034	R
6	1,388	R	1,6217	R
7	1,388	R	1,4209	R
8	1,309	R	1,5682	R
9	2,205	VG	2,1168	G
10	1,431	R	1,5027	R
11	1,001	RB	1,2311	RB
12	1,056	RB	0,9235	RB
13	2,144	VG	2,2846	VG
14	0,944	RB	1,1497	RB
15	2,262	VG	2,2052	VG
16	2,079	G	2,1622	VG
17	1,722	G	1,4738	R
18	1,463	R	1,4738	R
19	2,262	VG	2,1622	VG
20	1,603	R	1,4738	R

**Table 6.** Qualitative evaluations according to score. Source: Author's elaboration

When analyzing these results, the prevalence of the evaluations of Regular in both fields is evident, this is more easily observed in the graph shown in figure 1.

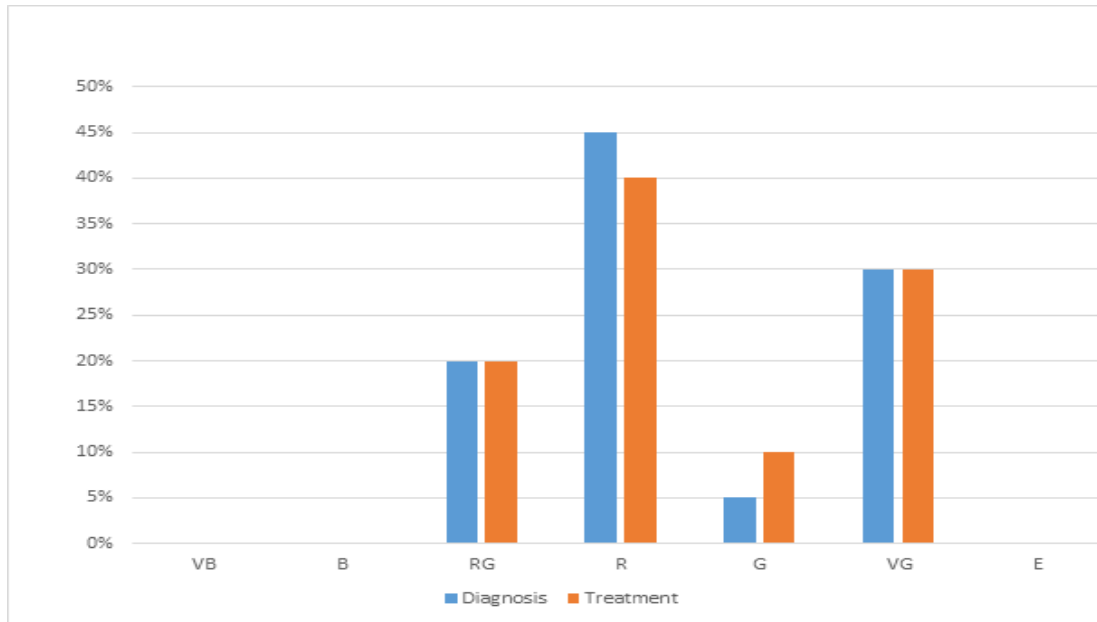


Figure 1. Relative Frequencies of the evaluations. Source: Authors

By applying the hierarchical clustering algorithm, the results of questions 1 and 2 of the questionnaire were added, about whether the student had received the first aid course and thus determine its impact on the evaluations obtained. As a result, we can observe two clusters, as shown in figure 2.

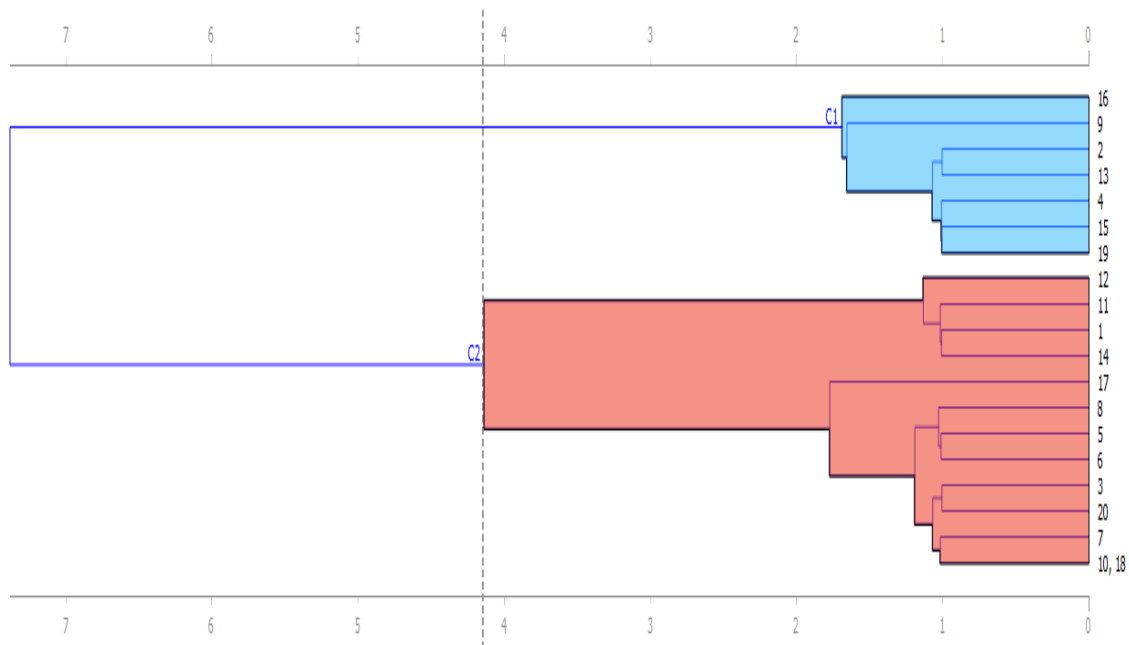
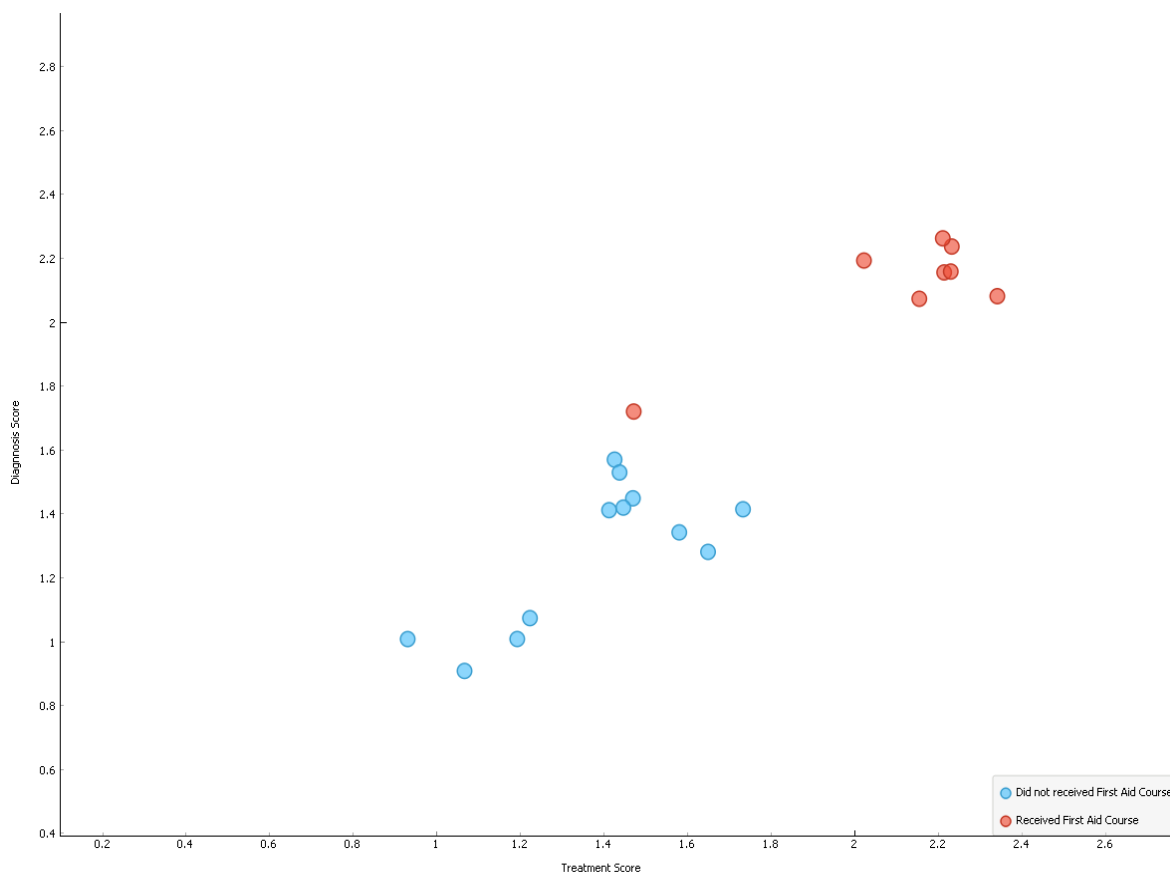


Figure 2. Hierarchical Clustering Dendrogram. Source: Author's elaboration

The first cluster (C1, in blue on the image) is formed by 7 students (35% of the total) with 6 VG (86%) and 1 G (14%) evaluations in both diagnosis and treatment. All these students received the first aid course.

The second cluster (C2, in red on the image) is formed by 13 students (65% of the total) with respective evaluations expressed in (number of students, %) of: G (1, 8%), R (8, 62%) and BR (4, 30%) in diagnosis and R (9, 69%) and BR (4, 31%) in treatment. Of these students, only one had received the first aid course.

For a graphical representation of the group's situation on the students' level of knowledge in medical-dental emergencies in general and its relation to the first-aid course, the scatter plot shown in Figure 3 was obtained.



**Figure 3.** Scatter plot for treatment score vs. diagnosis score. Source: Author's elaboration

As can be seen, the students who received the first aid course, got the highest evaluations in both fields, except for one student who, despite having received the course, obtained an R in the diagnosis. This shows an effectiveness of 88% for the course on the level of knowledge in medical-dental emergencies.

## Conclusions

There are few studies that certify the level of preparation of the student of dentistry in medical-dental emergencies, and the few investigations carried out show a deficient knowledge causing imminent risk of the patient's life and legal problems for the professional.

With the use of the single-value neutral sets, it was possible to associate linguistic terms to the experts' evaluation of the open questions of the applied questionnaire, making their quantification more reliable.

We also obtained that the level of knowledge of dental medical emergencies in the students of the tenth semester of UNIANDÉS, during the academic period April August 2019, has a majority negative valuation in 65%, with similar evaluations in the fields of diagnosis and treatment.

Only 40% of the students have taken the first aid course, which evidences the lack of interest to take such courses. However, from the results obtained, it is evident that this course has a positive influence on the level of knowledge in dental medical emergencies.

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